# CHAPTER 5

# TIMBER HARVESTING

# Timber Harvesting

## Pre-Harvest Planning

Proper planning for timber harvesting is imperative to minimize the potential impact to soil and water quality. Incorporating BMPs into a logging operation while carrying out that operation in the most efficient manner requires planning.

There are two stages of harvest planning: preliminary pre-harvest planning and comprehensive harvest planning. A pre-harvest plan is a fairly simple plan commonly prepared for a forest landowner by a DOF area forester, forestry consultant, or procurement forester prior to conducting a timber sale. The plan will identify recommended streamside management zones as well as potential problem areas such as fragile soils or steep slopes that may require special treatment during the harvesting operation.

A comprehensive harvest plan is much more detailed. The plan is usually prepared by the logger or logging manager just prior to beginning the harvesting operation. The logging plan may include recommendations on logging roads, log decks, streamside management zones, stream crossings, skid trails, and the schedule of activities. The logger must have the following information at his disposal:

1. *Type of cut* (clear-cut, row thinning, individual tree selection, etc.) – This could affect deck size and location, equipment restrictions, or job layout.

2. *Terms of the timber sale contract* – For example, the length of time on the contract may dictate the time of year that the tract will be logged, which may impact the haul road construction standards.

3. *Tract topography* – In the mountains, topography will often limit the logger's options for road and deck location. In addition to slope, aspect and exposure should also be considered.

4. *Tract soil conditions* – Soils will affect road and deck location, especially in the Coastal Plain and Piedmont regions. Soils also impact equipment decisions and scheduling of activities.

5. *Tract hydrology* – Knowing how much water to expect in a stream after a big rain will dictate stream crossing structures.

6. *Tract boundaries, easements, and rights-of-way* – This information is necessary to locate access points and haul roads and may be the limiting factors on accessibility for the site.

7. *Timber volume* – Timber volume to be removed by species and product, and the distribution of that volume across the tract. This information is vital for determining haul road standards, deck size and location, and scheduling.

8. *Logging system and equipment spread* – The planner must be intimately familiar with the characteristics of the logging operation, including any equipment limitations or operating constraints. For example, the type of log truck (tandem or tractor/trailer) will impact the haul road layout, acceptable curve radius, and landing size.

9. *Applicable laws and regulations* – Laws affecting logging, including but not limited to the current non-regulatory BMPs, Silvicultural Water Quality Law, Chesapeake Bay Preservation Act, and Clean Water Act. These could affect all aspects of the harvest plan.


There are several tools available to the harvest planner. Topographic maps, available from the U.S. Geological Survey, are a must in the Piedmont or Mountain regions. Soil survey maps are most important in the coastal plain regions, where soils impact logging operations much more than topography. Soil maps for most counties can be obtained from the Natural Resources Conservation Service. A detailed timber stand map can be of great assistance in planning log deck location and scheduling operations. Many landowners have these on file for their property, prepared by a DOF area forester, forestry consultant or forest industry representative.

An accurate estimate of slope is necessary to maintain acceptable road grade, determine spacing between required water bars, and to comply with various BMP recommendations. Plastic flagging of various colors is an important tool for the logging planner. Boundaries, log deck locations, "back-lines" for skidding zones, streamside management zones, and designated skid trails can all be effectively marked and distinguished by flagging or paint of different colors. Plastic flagging, paint and slope-determining instruments can be purchased from any forestry or engineering supply company.

### Steps to Prepare a Harvest Plan

The following 14 steps provide a framework for a comprehensive harvest plan:

**Step 1** Prior to but no later than three working days after commencement of an operation, the owner or operator shall notify DOF by calling the toll-free number below.

*This is a requirement of the law. Failure to notify can result in a Civil Penalty of $250.00 for a first offense and up to $1,000.00 for subsequent violations.*

## 1-800-939-LOGS

(1-800-939-5647)

**You will receive a confirmation number when calling this number.**

You will be asked for your phone number, when logging will begin, the county where it will occur, the location and the size of the operation. This information will be faxed to the appropriate regional office.

The DOF will assit with pre-harvest planning if requested. Pre-harvest planning guidance prior to moving equipment on the tract may lessen the chance of BMP or water quality problems later.

**Step 2** Study applicable maps and conduct an on-the-ground reconnaissance of the area to be logged. Note the slope, aspect, soils, timber, streams, wetlands, access, boundaries, old logging roads, and "indicator" plants. Document as you proceed. A good method is to carry a large-scale topo map covered with a sheet of acetate or mylar on a clipboard. Mark important details and locations on the acetate "map." Become familiar with all of the tract characteristics that will impact logging.

**Step 3** Identify and mark streamside management zones (SMZs). These are one of the most important and effective ways to reduce stream sedimentation in a harvested area, and should be implemented on all perennial and intermittent streams. Refer to Page 43 of this section for details.

**Step 4** Locate and flag log decks. These are critical decisions that will directly affect production. Log deck location is a tradeoff between skidding distance and haul road construction. A log deck should be on a slightly sloped area (to facilitate drainage) with stable soils that do not easily rut.

**Step 5** Locate and mark logging road stream crossings. Generally the best rule regarding stream crossings is not to have any if at all possible. They can be expensive and a potential source of major environmental and water quality problems. However, if it is determined that a stream crossing is necessary, choosing the proper location is critical. Look at the stream width, water depth, stability of the stream bottom and banks, the approaching topography and soils, and the normal high water mark. Choose a location that will minimize the chance of stream sedimentation arising from logging and hauling operations. As much as possible, locate log roads and skid trails outside the SMZ.

**Step 6** Locate and mark logging road entrance points from public roads. The law requires that a truck driver pulling onto the highway from a temporary log road be able to see clearly in either direction for a minimum of 200 feet. Contact your local VDOT office for specific concerns regarding your tract.

**Step 7** Locate any other logging road "control" points. These are points or locations that the logging road must either connect or avoid. Entrance points, stream crossing locations, and the log deck locations are all "positive" control points for the haul road network. Examples of "negative" control points are rock outcrops or gumbo clay flats–areas through which the haul road cannot pass.

**Step 8** Locate and flag the logging road gradeline (in the mountains) or centerline (in the coastal plain). A good procedure is to first attempt to plot the gradeline on a topo map, connecting the positive control points while keeping the road at an acceptable grade (recommend maximum 15 percent grade for no more than 200 feet at a time). Ideally, the grade should be kept at 10 percent or less. Locating a centerline on relatively flat coastal plain terrain is usually somewhat easier. Soils are often the main consideration. Try to locate the haul road on well-drained, stable soils with good load bearing capacity such as clay or sandy clay loams with a solid base.

**Step 9** Locate and flag designated skid trails, if necessary. In general, "bladed" designated skid trails should be avoided if at all possible as they greatly increase environmental impact through erosion and stream sedimentation.

**Step 10** Specify logging road construction standards. There are generally three logging road standards:

1. The most common is a "branch" logging road. It is designed as a temporary road that will be "retired" immediately after logging is completed. A branch road is usually not much more than a 10-12 foot wide trail where the surface organic material has been graded off. There is no surfacing, and drainage is handled through a few well-placed water turnouts or broad-based dips.

2. A "primary" logging or forest road is designed for permanent, all-weather use. It has a 20-foot wide subsurface, permanent ditches, cross-culverts, stabilized banks, and occasional crushed rock surfacing. A primary road is expensive and can only be justified on very large timber sales where the road will be used for several years.

3. A "secondary" logging road has a narrower subsurface than a primary road, with water control devices installed, but without surfacing. It is designed for all-weather use, and is a good choice for extended logging jobs that must operate year round.

   Consider the use and availability of temporary road stabilizing or surfacing options such as crushed rock, geotextiles or mats (wooden, metal or rubber). These are best applied at potential "trouble spots" *before* a problem occurs.

**Step 11** Specify stream crossing structures. The common choices, from least to most expensive, are a ford, a culvert with dirt fill, a "low-water" bridge and an elevated timber bridge. The "best" choice depends upon the cost, the stream characteristics, the amount of use anticipated, the load bearing requirements, the area of forestland drained by the stream, the previous "high-water" mark, the time of year the structure will be used, and the environmental impact.

A proper stream crossing structure will minimize any disruption to the normal stream flow and pattern. Type and method of harvesting may influence culvert size. Refer to the section on stream crossings in this chapter for more details.

**Step 12** Determine the schedule of operations and harvest patterns. The most efficient schedule of operations depends on tract topography, time of year, current and anticipated weather conditions, road construction requirements, cash flow, and other outside factors. Equipment maintenance, safety meetings and planned holidays or mill shutdowns should be included in scheduling. Scheduling should be constantly refined and updated as the operation progresses.

**Step 13** Specify tract "close-down" requirements. These primarily involve the implementation of BMPs that will minimize erosion and stream sedimentation on the tract in the period after harvesting has been completed. They include re-grading ruts, installing water bars on abandoned roads or designated skid trails, reseeding landings and roads, removing any temporary stream crossing structures, scattering brush, opening ditches or water turnouts, and any clean-up necessary to leave the tract in acceptable condition. Close and gate roads to unauthorized traffic.

Many of these operations can be scheduled during "slow" times as harvesting is completed on various parts of the tract, thereby avoiding a massive job at the end. It is important to make the landowner aware of his responsibility to maintain the tract in the environmentally sound condition in which it is left after logging is completed and BMP compliance recorded.

**Step 14** Determine if permits are required and obtain them. The Virginia Marine Resources Commission has regulatory control over most of the stream bottoms of Virginia. Through mutual agreement between the Virginia Marine Resources Commission and the Virginia Department of Forestry, any stream crossing that has more than a 5 square-mile watershed drainage area above the crossing will require a permit from the Virginia Marine Resources Commission. The permit application can be obtained from the Virginia Marine Resources Commission at the address located in Appendix E.

Any crossing on streams below the 5 square-mile watershed threshold will have to adhere to the Best Management Practices for Stream Crossings as outlined in this manual.

## Logging Systems for Effective BMP Implementation

A logging system is the combination of equipment and personnel used to harvest timber. Logging systems can be described in detail by all of the functions used to develop the harvest (felling, yarding, processing, and loading).

*For this general discussion on BMP implementation, logging systems will only refer to the primary method used to move the tree from the stump to the landing.*

Logging systems, or tools to harvest timber, have evolved to be responsive to different harvesting conditions. As harvesting conditions change, so have the tools to harvest timber. Today, this evolution in logging systems results in a wide variety of specialized harvesting tools, each designed to effectively harvest timber in particular conditions. As public acceptability of harvesting's adverse environmental impacts has decreased, logging systems have evolved to decrease these impacts.

As the utilization of the timber resource has pushed harvesting on increasingly difficult sites, logging systems have evolved to be effective in challenging both timber and terrain. This evolution has resulted in a logging system toolbox, each tool being suited to a particular set of conditions. Proper application of logging systems means applying the tools to the set of conditions for which it was designed. Proper application of a logging system can result in both cost effectiveness and minimal adverse impact to the forest environment.

Improper application of a logging system usually results in increased harvesting costs and/or undesirable environmental impacts. Effective BMP implementation to mitigate harvesting impacts is dependent on the proper logging system application. The environmental impacts of improper logging system applications cannot usually be cost-effectively mitigated through BMP implementation, particularly on more challenging timber and terrain.

As a simple example, larger skidders were developed to skid larger timber. Small skidders and large skidders could represent two logging systems. When a large skidder is applied to a small timber tract, the result is increased costs as well as the potential for increased damage to the residual timber. Increased costs come through payloads lower than capacity (too many trees needed to get payload) and increased damage potential (choking stems) because of the reduced maneuverability of the larger skidder. Proper selection and application of a logging system, such as skidder size in this example, is key to minimizing harvesting costs as well as environmental impacts.

### Logging System Descriptions

These are examples of some of the basic harvesting systems used today:

1. *Animal* – Horses or mules to pull logs or carts suspending logs. Animal weight, number of animals, and species of animal vary to provide varying skidding capacities.

2. *Tracks* – Use of track laying tractors to pull logs or arches suspending logs. Tracks may be hard as in dozers with rails or soft as in KMC with torsion bar suspension. Tracked systems may have winches, grapples, or swing boom grapples. Track length, width and grouser patterns vary for differing weight and horsepower classes.

3. *Skidder* – Use of rubber tired articulated tractors with integral arch to pull logs. Skidders may have winches, grapples, both, or swing boom grapples. Tire width and grouser pattern can vary for differing weight and horsepower classes.

4. *Shovel* – Use of hydraulic excavator based loader/shovel to bail logs. Reach, track length, width and grouser patterns vary for differing weight and horsepower classes and may be combined with processing heads, grapples, grapple saws, felling heads, excavation buckets, live or dead heels, and quick connections to transform into a multi-function machine.

5. *Forwarders* – Use of rubber-tired tractors equipped with log bunks and loader to transport logs free of the ground. The number of axles tires, weight capacity and loader size vary for differing weight and horsepower classes.

6. *Cable* – Use of a cable yarder and carriage to yard logs, either with one end suspended or completely suspended by wire rope. A yarder is logging equipment combining winch drum and steel spars or towers. Cable yarders may be mounted on tracks, truck, trailer, or sled. Tower height, number of winches, line size and line length vary by horsepower and weight class. A carriage is the device that moves in and out from the yarder to the timber and accommodates chokers or a grapple for hooking logs. Carriage characteristics are non-slack pulling or manual, mechanical, motorized slack pulling, radio, cycle, or mechanically controlled, single or multiple span.

7. *Helicopter* – Use of helicopters to vertically lift timber from the stump and fly fully suspended to the landing. Helicopters used in logging have different lifting capacities.

## Logging System Selection

The proper selection of a logging system involves consideration of many different conditions such as slope, terrain shape, yarding distance, weather, soils, tree size, volume per acre, size of tract, cost of road construction, cost of logging, and productivity goals. The following table lists the logging systems and the various characteristics of each systems niche. The niche, or place, for a logging system is the application where the harvesting costs and the environmental impacts are minimal when compared to other logging systems.

The table and narratives on the following pages describe each of the logging systems niche.

| Table 4<br>Logging System Application | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Logging System | Weather Sensitivity | Terrain Slope % | External Yarding Distance | Average Tree Size | Volume Per Acre | Volume Per Tract | Cost of Road | Terrain Shape & Length |
| Animal | Moderate | < 20% | < 500 ft | Small | Low | Small | Low | Flat short |
| Tracks | Moderate | < 40% | < 800 ft | Large | Common | Small | Low | Moderate short |
| Skidder | High | < 35% | < 1500 ft | Medium | Common | Medium | Med | Flat + common |
| Shovel | Low | < 45% | < 400 ft | Medium | Common + Clear cut | Small | Low | Moderate broken |
| Forwarder | High | < 30% | < 2500 ft | Medium | Low | Large | High | Gentle long |
| Cable | Low | Any | < 1500 ft | Medium | Common + | Medium | High | Steep Concave long |
| Helicopter | Low | Any | < 6000 ft | Large | High Sawtimber | Large | High | Any |

## Logging System Application

*Animal* – Using animals to skid timber is best applied in flat terrain, close to existing roads, and in a publicly sensitive location. The sensitivity may be a recreation site, a trail, a road, or a residential viewshed. The system is limited by the weight of the animals and their ability to exert pull, and in general can be used in up to 20 inch timber on favorable slopes. Because of the low productivity and low move costs, small tracts can be harvested economically.

*Tracks* – Tracks are best used where short, steeper slopes prohibit overland rubber tired skidding. Because of the slower travel speeds, yarding distance is limited and roads should be either existing or inexpensive to construct. Soft tracks, or high-speed torsion bar suspended tracks, can extend the efficient skidding distance and operate on somewhat steeper slopes than traditional hard tracks. Swing boom grapple tracked machines can be effective in larger timber on steeper slopes at short distances. These can be used on wetter sites or in moderately inclement weather.

*Skidder* – Rubber tired skidders have application in the broadest range of logging conditions of any logging system. This is why skidders are the conventional logging system in Virginia. Skidders are a flat ground system, but with winches can be effectively used on flat-to-moderate slopes. Skidding is the default logging system selection except when: 1) logging is necessary in inclement weather; 2) skidding distances are longer than 1,500 feet due to the cost of road construction; or 3) a dozed road is necessary for the skidder because slope is excessive. Under these conditions other logging systems should be considered. Tire widths can be increased to operate overland on steeper slopes and on wetter sites.

*Shovel* – Shovel logging is limited to clear cutting when it is necessary to pick up and swing the timber toward the road (bail). Shovels can work in adverse weather, in wet areas and on steeper slopes because they are not dependent on tractive effort to move the timber. Shovels are best applied in common + timber volumes clear cut per acre, logging in adverse weather, and/or on steeper slopes where yarding distance is generally less than 400 feet and roads are either existing or inexpensive to build due to the shorter yarding distance.

*Forwarder* – Forwarders are best applied where longer yarding distances in fairly gentle terrain is needed to avoid expensive truck road construction, or where the volume to be harvested per acre is low and does not justify truck road construction. Scattered pieces can be picked up and forwarded. It is suited to larger tracts with existing trails that can be used as is without the need for truck road construction, and for yard distances of 1,500 or more feet.

*Cable* – Cable logging systems are best applied where, due to excessive slope, ground based systems require excavated skid roads to operate, when harvesting in adverse weather is necessary, or where compaction due to ground based systems is unacceptable. Logging uphill up to 1,500 feet is most efficient, however downhill and cross canyon cable systems can also be used effectively. Terrain features control the landing, cable corridor pattern, and the acres that can be harvested from a setting. Because there must be a sufficient volume of timber on each setting to make it economically efficient, higher than common timber volumes and value are generally needed.

*Helicopter* – Helicopter logging is best applied when road costs are high, large volumes must be moved in a short period (salvage or keep the mill running), sawtimber only is planned for harvest, harvest in adverse weather is needed, or when the landowner's objective is to minimize the environmental impacts of harvesting. This harvesting option, due to the expense, should be considered when other options are unsatisfactory. Maximum flight distances should be less than 6,000 feet to maintain an average of 2,500 feet or less. Flight paths can be uphill or downhill but are limited by power lines, roads, houses and other improvements.

Maximum log size is limited by the lift capacity of the helicopter used. Helicopter logging will stop when visual contact between the pilot and ground crew cannot be maintained (fog), or when the wind is >30 mph, or when icing conditions (jet intake 30-34° F) are present. Due to the high productivity, 80-100 mbf/day, extensive landing and trucking support is required.

Swing System – Swing systems are combinations of logging systems to move the timber from stump to a full service landing. They may or may not involve a swing landing, which is a concentration point between the logging systems employed. The combination of logging systems allows each system to operate in the terrain on which it is most efficient. For example, since tracks can operate on steeper slopes than skidders, yet are limited in the distance to which they can pull, combining tracks with grapple skidders allows for logging on steeper slopes at greater distance than either tracks or skidders alone. If the distance is even greater, combining tracks with a forwarder would be efficient. Another good option for steeper slopes at longer distances is a shovel-skidder swing; however, it is applicable only to clear cutting operations.

The following table lists some swing systems that have good application.

**Table 5**
**Swing System Application**

| Swing System | Application |
|---|---|
| Tracks to skidder | Short steep slopes to flat ridge or flat bottom |
| Shovel to skidder | Short Steeper slopes to flat ridge or flat bottom |
| Skidder to fowarder | Moderately steep slopes to long flat ridge or bottom |
| Skidder to cable | Flat slopes/bottom to steep slopes (up a cliff, across a river) |
| Cable to skidder | Steep slope to moderately steep ridge |